Grand Canyon Water
Reclamation Plant
(Water Re-Use System)
(Water Disposal System
Grand Canyon National Park
Coconino County
Arizona

HAER No. AZ-3

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Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20240

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HISTORIC AMERICAN ENGINEERING RECORD

AZ-3

GRAND CANYON WATER RECLAMATION PLANT

(Water Reuse System)(Water Disposal System)

Date: 1913, 1926.

Location: Grand Canyon, South Rim
Coconino County, AZ.

Designed by: Hommon, Harry B. (1926)
Tillotson, M.R.
Davenport, George L.

Owner: National Park Service.

Significance: The Grand Canyon Water Reclamation Plant was one of the earliest systems for the industrial reuse of sewage in the western U.S. The system is comprised of a sewage collection system, treatment based on activated sludge, and a system for distributing the reclaimed sewage for use in the park. The system has undergone only minor changes since its construction in 1926.

Historian: Dennis M. Zembala, 1977.

Edited and
Transmitted by: Monica E. Hawley, Historian, 1983.

GRAND CANYON NATIONAL PARK WATER RECLAMATION PLANT

The peculiar geologic features of the Grand Canyon region meant that there was not enough water at the park to provide services which early tourists considered essential - namely flush toilets and modern sanitation facilities. The plateau through which the canyon is cut is made up of sedimentary layers which have a region-wide downward slope to the south.[1] The water table emerges on the north wall of the canyon where there are numerous springs,[2] but is not found on the south wall. A small spring at Indian Gardens on the south wall provided drinking water for early visitors, but it proved inadequate for the type of development which began in 1904.

Before mass distribution of the automobile, visitors to Grand Canyon were drawn from a class of society which had already become accustomed to what was, then, the luxury of indoor plumbing.[3] The Santa Fe Railroad which built the El Tovar Hotel (1904) at the South Rim, directed its promotions toward the tourist who could afford a ticket from a distant city and an extended stay at a resort hotel. As was the case with other national parks in the West, early visitors were mainly middle and upper class urban dwellers seeking the recuperative effects of nature and wilderness made popular by Teddy Roosevelt.[4] The El Tovar included baths and flush toilets even though all water was shipped in by the railroad in tank cars. The number of visitors to the park increased from 15,050 in 1905 to 27,500 in 1915, severely straining the existing water supply and the waste disposal system which consisted of a small septic tank about two hundred yards south of the hotel. About 1913, the Santa Fe Railroad built a sewage treatment plant to remove the overload from the original septic tank and provide water for secondary purposes where potability was not necessary.[5] The plant, which stood in the middle of the railroad's right-of-way was an early attempt to combine the principles of sewage treatment and water purification to produce a useable effluent. Unfortunately, the sewage treatment half of the plant did not produce an effluent capable of purification by a filter. Rather it was a system commonly used to produce an effluent which could then be discharged into a nearby river.

It conisted of septic tanks used in conjunction with contact beds of crushed stone. The septic tanks were used to remove settleable solids and to decrease the volume of organic material through the action of anaerobic bacteria already present in the wastes.[6] In addition to the septic tanks, the 1913 plant also utilized contact beds to further reduce the organic solids suspended in the tank effluent. These contact beds were essentially concrete tanks filled with coarse, crushed stone. The bed was flooded with effluent, allowed to stand for a short time, drained and then rested for up to 8 hours. During the resting stage, the organisms attached to the crushed stone digested some of the remaining organic material in the absorbed sewage. This digestion consisted of the bacterial oxidation of organic carbon with the corresponding release of carbon dioxide. Hence, it was important that the spaces between the stone be large enough for the free passage of air. The interstices between the stones also served as a home for a variety of larger organisms such as worms, spiders and small flies[7] which helped to further reduce the content of organic material. There were two contact beds at Grand Canyon and they were used in series, the effluent passing from the primary to the secondary bed. The efficiency of this type of system is not very great and its use was generally limited to smaller towns where the amount of sewage was not large and where it was dilute enough not to clog the beds. At the Grand Canyon, the sewage was strong due to the scarcity (and, hence, high cost) of fresh water. Water was used sparingly and the concentration of waste material was high in proportion to the total volume entering the treatment plant. Nonetheless, the effluent was passed through rapid sand filters and was used where possible to irrigate lawns and to supply water to locomotive boilers.[8] Excess effluent was not run through the rapid sand filters but was simply turned into an open ditch leading away from the grounds. This arrangement was a nuisance since the effluent still had a bad odor in spite of the treatment. As the number of visitors to the Canyon increased, the problem became more acute.

The increasing popularity of the Grand Canyon created a crisis at the old sewage treatment plant. Water usage went from 1.2 million gallons in 1918 to 2.4 million gallons in 1923.[9] Furthermore, the Santa Fe Railroad and the Fred Harvey Company which ran the concessions planned to enlarge their hotel and the National Park Service was improving facilities for automobile visitors. By July of 1923, the situation had deteriorated enough to warrant a visit by the Assistant Surgeon General of the U.S. Public Health Service.[10] This visit resulted in an inspection tour by the engineer responsible for sanitation in the national parks. The engineer's report gave detailed instructions for cleaning the older plant and restoring its capacity for limited purification. It also suggested that other means be developed to dispose of the sewage that was not reused and pointed out the dangers of contaminated water running in an open ditch. The report stated that whatever solution was finally adopted, the expense would be large enough to justify the reconsideration of the park's complete water and sewage system.

Harry B. Hommon, the sanitary engineer detailed to the national parks, was one of a new generation of specialized professionals which emerged as a result of the sanitary reform movement at the turn of the century. Formal training at a university gave such engineers a more thorough background in basic sciences and the scientific method than most of their predecessors. Harry B. Hommon, the engineer responsible for the new Grand Canyon plant, had received a bachelor of science degree in sanitary engineering from Ohio State University in 1903. After serving as assistant chemist at the Columbus (Ohio) Sewage Testing Station, Hommon designed similar testing stations at Gloversville, N.Y., Akron and Cleveland, before becoming chief engineer of Chicago's testing station in 1909. From 1914 until 1922, Hommon was in charge of the Public Health Service's experimental studies to devise methods of purifying industrial wastes.[11] As a contributing reviewer to that agency's Public Health Engineering Abstracts, he was able to keep abreast of the latest theories and developments in sewage treatment. Furthermore, during 1920, Hommon participated in a Public Health Service survey of sewage purification practices at plants across the country.[12] His experience at various municipal plants in the East and his survey of plants across the country made him aware of the extent to which local conditions influenced the design of sewage treatment facilities. Length and severity of winters, availability of water, strength of the sewage, type of waste and a dozen other related factors all influenced the choice of the type and size of plant suitable for a particular location. Sensitivity to this situation was an important factor in the success of the new installation at Grand Canyon.[13]

The use of the activated sludge method of purification was the principal reason that Hommon's design worked, while the earlier plant did not. The 1913 installation was a first-class operation, built by the Santa Fe's engineers at a cost of about $20,000, but it was not suitable to either the site or the purpose. The activated sludge process, on the other hand, produced a high quality, odorless effluent capable of further purification and reuse. Hommon was aware of the development of this relatively new method and of the situations in which its application was called for.

Briefly, the activated sludge process of sewage purification consists of the digestion of dissolved and suspended organic matter by certain bacteria capable of oxidizing it to sludge, carbon dioxide and water. The sludge contains the digesting bacteria and is easily settled out for disposal and for reuse in seeding the next batch of sewage. In fact, such decomposition of organic substances in the presence of oxygen takes place in every stream where the current and fall are sufficient to aerate the water. That is to say that every stream of any size has a limited capacity to purify its waters. In line with this, sewage treatment plans based on the principal of oxygen activated bacterial sludge took advantage of one of nature's own processes. An activated sludge plant is analogous to a bacterial-breeding farm in which the bacteria are contained in a mass of open-mesh fibers. Oxidation of organic matter in this environment requires the presence of oxygen which is then converted to carbon dioxide. The development of the process came after an period of basic bacteriological research in which the presence of these organisms in nature and their capabilities were gradually recognized.[14]

As logical as it may seem, the choice of an activated sludge plant for Grand Canyon was not a clear one at the time. A plant of the type built in 1913 by the Santa Fe was very inexpensive to operate when compared to an activated sludge plant. With the use of gravity feed and automatically controlled valves, it could run for weeks with minimal supervision and expense. On the other hand, an activated sludge plant required a trained operator and a considerable cash outlay for power to run the air pumps and electric motors. Pumps were necessary to assure the constant supply of oxygen necessary for the growth of aerobic bacteria and the sedimentation tanks were powered electrically. All this was considerably more expensive than a system of septic tanks, contact beds and filters, and had to be justified in economic as well as in public health terms.

Construction of the New Plant

During the winter of 1923-1924, the railroad took measures to clean the old plant, but it had already been decided that a new one was sorely needed.[15] In June of 1924, Hommon submitted a cost estimate of $72,000 for a new plant and a budget request was submitted for that amount for the fiscal year 1926 (beginning June 1925). This preliminary estimate called for a conventional sewage treatment plant with Imhoff tanks and contact filters, but Hommon was already leaning toward an activated sludge plant.[16] He spent the time from January to June reviewing alternatives and designing the new plant with the help of M. R. Tillotson, the park engineer, and George L. Davenport, Assistant Engineer with the railway company. A tentative decision to use the activated sludge process was made in February when the three men met at Hommon's San Francisco office. Implementation depended on the willingness of the Santa Fe Railroad to provide free electricity for the plant's blowers and to assume part of the costs of construction.[17] Electrical current would comprise a large part of the cost of operation, and it was a simple matter to caluculate whether this amount would be lower than the $3.09 per 1000 gallons the railroad was paying to haul water from Puro, Arizona. Hommon began preparing plans for the individual components, and on May 9, a final conference among Hommon, Tillotson, Davenport, R. B. Ball (Santa Fe's Chief Engineer), and Park Superintendent J. R. Eakin, was held at the Canyon. This meeting was to determine the exact shape and disposition of the plant and sewer lines.[18] Shortly after this meeting, Hommon and Davenport visited an activated sludge plant at Pasedena, California, to get a more exact notion of the final design of the Grand Canyon facility.[19] All that remained before construction could begin was to determine what costs would be paid by each party. After six months of negotiating it was decided that in addition to providing electricity, the Santa Fe would build that part of the plant pertaining directly to purification, while the government would build the sewage treatment section. The Park Service would pay the salary of a skilled operator to run the plant while the railroad provided casual labor. The main 10-inch trunk line sewers were to be constructed and maintained by the government. The agreement further stipulated that 90% of the reclaimed water would belong to the railroad and 10% to the Park Service. After much discussion of details, a formal contract was signed in December, and construction began immediately.[20]

In order to have the plant operating for the 1926 tourist season, most of the work was done in the dead of winter. By mid-January, the plant was 80% complete, including most of the concrete work. Because of freezing weather the green concrete was covered with tarpaulins and heated for 120 hours. Whenever possible, the engineers used power machinery to speed the work. This equipment included rock drills, a pneumatic pipe-caulking machine and a pneumatic clay digger. In all, over 6500 cubic yards of material were excavated (one-third of it in solid rock) and over 4 miles of pipe was layed by spring.[21] The first sewage was turned into the line on May 29, 1926, but it was several months before the plant was functioning fully.

The difficulties encountered in building the reclamation plant were almost matched by those of getting it to run properly. It was immediately apparent to Hommon and his associates that its operator would have to possess more training and skill than was at first thought necessary. Unlike an installation of septic tanks and trickling filters, an activated sludge plant required almost constant attention by skilled personnel. Hommon had counted on just occasional supervision by the Park Engineer. Once government representatives had resigned themselves to the additional expense, they found that getting a capable operator was no easy task. The first operator was a Public Health Service engineer who had formerly been assigned to Yellowstone.[22] This man was evidently incapable of managing the technology of an activated sludge plant because by June 15, algae and mosquitoes were breeding in the tanks and the sludge refused to settle in the clarifier.[23] This was due to the insufficient quantity of bacteria in the aeration tanks, a situation common in new plants and one which would rectify itself in time. A more critical problem was the necessity of on-site bacteriology analysis. The clarity of effluent was no guarantee of its purity and an operator would have to be able to keep accurate records and perform the proper laboratory tests to determine the efficiency of the process. When a new operator was hired, Hommon made sure that he was familiar with the activated sludge plants at Lodi and South Pasadena before sending him to the Canyon.[24]

The construction and continued existence of the Grand Canyon facilities poses some interesting questions about the history of American sanitary engineering and public works. Its success in producing a virtually potable effluent demonstrated the technological capability for returning wastewater to streams and rivers in a relatively pure state. Given this fact, then why didn't cities and towns adopt such methods to prevent pollution of our watercourses? The answer is readily revealed by an examination of the plant itself.

A preliminary survey of the Grand Canyon plant immediately reveals that it was designed to reclaim water rather than purify sewage. After passing through a Parsall flume and a bar screen chamber, the raw sewage entered the presettling tank.[25] This tank (9x17 feet) was built with a double hopper bottom, so that grit, grease and as much solid waste as possible could be settled out and diverted around the remainder of the plant. The valves were periodically opened and the sludge in the hoppers was sent directly to an outfall south of the park with no treatment at all (there was another valve which allowed the operator to bypass even the presettling tank). The effluent from these tanks was piped to a small diversion chamber containing still another bypass valve. That portion to be reclaimed was carried in a 10-inch cast-iron pipe to a covered concrete trough between the two aeration tanks. The sewage entered the aeration tanks at the southern end through two gates, one to each tank, and gradually moved through the tank during the aeration process. The two aeration tanks were the heart of the activated sludge system. Each was 42 feet by 8 feet by 10 feet deep and designed for a holding period of six hours. Air was pumped into a channel in the bottom of the tank and entered the sewage through diffuser plates (12x12x1-1/2 inches) set in a continuous row over the channel. Sometimes called filtros plates, these porous slabs were grouted into the channel and supported transversely by iron T-sections.

When the sewage left the aeration tanks, it was very turbid due to the suspended sludge particles in solution. It was carried in an effluent channel to the clarifier, a square tank (16x16 feet) with a funnel-shaped bottom where the sludge was allowed to settle. A motor-driven sweep with a rubber blade concentrated the settled sludge at the center, where it was removed by an outlet pipe. After about 3 hours in the clarifier, the effluent passed over the top of the tank into a trough leading to the secondary settling tank (4x16x10 feet). This tank was originally intended as a coagulation basin preliminary to filtration but it was found that simple settling was adequate to remove most of the remaining sludge.[26]

The remaining steps in the reclamation process were derived from techniques devised to purify water for human consumption. After clarification, the effluent was passed through rapid sand filters, esentially beds of sand and gravel (77x10 feet) to a depth of about 20 inches. These filters now (1977) contain ground anthracite coal but were originally layered from bottom to top with 8 inches of coarse gravel (passing 2-1/2 inch screen and retained on 1-1/2 inch screen) on the bottom and a layer of either No. 1 or No. 2 sand on top.

By 1920, rapid sand filters had become standard in municipal waterworks because their cleaning mechanisms eliminated the extensive labor formerly required to clean slow-sand filters.[27] At Grand Canyon, a tank containing water to backwash the filters is located on a small hill about 100 yards northwest of the plant. This tank or one similar to it was located immediately next to the plant in 1926.[28] The date and reason it was moved are unknown, but it was probably done to gain additional pressure and may have coincided with the introduction of powdered coal in the filters. It is possible that the coal was more dense and made the filter more resistant to the force of the backwash, thus requiring greater pressure. During construction, Hommon realized that the rate of flow during washing would be greater than the capacity of the outfall sewer line. For this reason and because of the value of the water, he decided to build a recovery tank to collect the washwater.[29] A 12-inch sewer line carried the effluent to this tank from whence it was pumped back to the presettling tank over a period of several hours.[30]

After passing through the filters, the reclaimed water enters the clear well (16x16x5-1/2 feet deep) below the floor of the air pump room where it is chlorinated and pumped to the reclaimed water tank. The original method of cholorination was with a "semiautomatic" machine activated by the force of the current in the main.[31] When the pumps were turned on, the current moved a vane in the line, thereby opening a valve which allowed a chlorine solution to enter the clear well.[32] A later chlorine machine functioned in a similar manner, but used chlorine gas instead. Chlorine gas is presently added by a simple regulator located outside the building.[33] The chlorinated reclaimed water is pumped to a nearby storage tank (200,000 gallons capacity) and from there to the village where distribution is in separte lines painted red to prevent accidental human consumption.[34] (A high level of chlorination is an additional precaution to prevent this occurance. The chlorine gives the reclaimed water a strong odor and taste.)

It is obvious that while Hommon referred to the facility as a "sewage treatment plant," it was designed primarily to reclaim water. In 1927, the average volume of sludge wasted per month was about 20,000 gallons, including 600 gallons of undigested solids per day. Laundry wastes were also bypassed at first, since they prevented the Santa Fe from using the effluent in steam boilers.[35] Whenever a problem forced the plant to shut down, the raw sewage was simply sent to the outfall, a practice totally incompatable with modern concepts of sewage treatment. Simply stated, the plant was built because visitors demanded certain sanitary facilities and both the railroad and the Park Service saw that the additional water could be provided more cheaply by reclaiming sewage than by hauling in tank cars. In 1927, the cost of reclaiming 1000 gallons was $.57, while the value of water from Puro was $3.09 per thousand.[36] While Hommon may have thought of this plant as a model for future sewage treatment, those who paid the bill did not. Neither did the public works managers of most cities. It was far easier and less expensive to build an adequate water purification plant to supply potable water from a polluted stream than to thoroughly treat sewage and maintain clean water courses. Until recently, rivers and streams were considered as part of our national sewage purification system.[37] Only when people began to perceive the need for clean rivers and translated that need into law did this 50-year-old technology begin to receive more widespread use.

FOOTNOTES

1. Edmund C. Garthe & Wilfred C. Gilbert, "History of Wastewater Reuse at the Grand Canyon," Unpublished report on file at Grand Canyon National Park.

2. Most notably, Roaring Springs which now provides the south rim with water through a 12.4 mile pipeline across the canyon.

3. Grand Canyon was made a National Reserve in 1893 and a National Monument in 1908, but was not, technically, a National Park until 1919, three years after Congress created the National Park Service.

4. William C. Everhart, The National Park Service (New York, 1972) p. 116; James Flink, "Automobility and the National Parks," Paper presented to American Studies Association; San Antonio; Nov. 6, 1975, pp. 4-5.

5. T. Lindsay Baker, "Grand Canyon Water Reuse System," Site Report, August 20, 1973, HAER Inventory of Southwest.

6. Metcalf, Leonard and Harrison P. Eddy. American Sewerage Practice, Vol. III. New York: McGraw-Hill, 1915, pp. 12-17; Hommon, H. B. and E. J. Theriault & H. H. Wagenhals, Sewage Treatment in the United States, Public Health Bulletin No. 132, Washington, D. C.: G.P.O., 1923, pp. 120-121.

7. Metcalf & Eddy, p. 223, pp. 512-515.

8. Letter. H. B. Harmon to W. W. Crosby, Oct. 12, 1923, Grand Canyon National Park. File No. D5031, Sanitary Systems.

9. This data is drawn from records of the Grand Canyon National Park.

10. Letter. W. F. Draper to Col. W. W. Crosby. July 28, 1923. Grand Canyon National Park. File No. D5031, Sanitary Systems.

11. Down, Winfield S. (ed), Who's Who in Engineering. (Fourth ed.), New York: Lewis Historical Publishing Co., 1937.

12. The results of this survey, published by the Public Health Service in 1923, seem to have been instrumental in reforming current practices. During the course of this survey, he and his colleagues visited numerous plants from New England to Texas.

13. Obviously the situation at Grand Canyon was rather unique, both because of the sites topography and the need to prevent any contamination of the Colorado River.

14. Much of this pioneering work with sewage bacteria was done by the Massachusetts State Board of Health at its experiment station in Lawrence, Massachusetts. (See Mass. St. Bd. of Health. Annual Report (1913)).

15. George Davenport to Park Superintendent Crosby, December 5, 1923.

16. Preliminary Estimate, June 24, 1924.

17. J.R. Eakin to H.B. Hommon, April 29, 1925.

18. One of the ranchers south of the park had tried to get the outfall located so he could file a claim for damages (H.B. Hommon to J.R. Eakin, May 13, 1924, et seg.).

19. Actually this trip was probably more for Davenport's benefit, since Hommon had visited several activated sludge plants in his 1920 Survey for the Public Health Service.

20. Agreement between Stephen T. Mather, Director of the National Park Service on behalf of the United States of America and the Atchison, Topeka and Santa Fe Railway Company, Y.G.C.NP. File, December 29, 1925.

21. 4 miles of vitrified pipe and 0.44 miles of cast-iron pipe. The later was used on trestles and in the two inverted siphones (782 feet and 424 feet actual length). See M. R. Tillotson, "Preliminary Report of Sewage Disposal System," G.C.N.P. Engineer's Office, January 18, 1928, p. 5.

22. H.B. Hommon to J.R. Eakin, April 8.

23. As a result, the filters were clogging and required backwashing several times a day. See H.B. Hommon to J.R. Eakin, July 8, 1926. Some of the clogging was due to the use of too fine a sand.

24. Dario Travaini, the new engineer, had been working for the Standard Oil Co., but had been trained in sanitation and was anxious to return to the field. Hommon sent him to observe laboratory procedures at the California State Board of Health Lab, and furnished him with a small library of technical books. (H.B. Hommon to J.R. Eakin, Sept. 23, 1926). Travaini eventually became Director of Public Works for Phoenix, Arizona.

25. H.B. Hommon, "Sewage Treatment Plant at the Grand Canyon National Park," Public Health Reports, Vol. 43, No. 4 (Oct. 5, 1928), p. 2587.

26. Settlement of suspended solids with a coagulant was an ancient technique of water purification. After 1855, the use of alum prior to filtration had become common practice; Moses N. Baker, The Quest for Pure Water, New York: American Waterworks Association, 1948, p. 299.

27. Rapid sand filters became widespread in the 1870s, largely replacing slow sand filters which had to be cleaned and scraped by hand. The rapid sand filter used a reverse flow or backwash to remove the impurities accumulated in the surface layers of the sand. (See Baker, pp. 179-277.)

28. The original tank was described as "a 12,000 gallon corrugated iron wash-water tank." U.S. National Park Service, "Preliminary Report of Sewage Disposal System," Grand Canyon Engineer's Office, 1926.

29. H.B. Hommon to J.R. Eakin, August 11, 1925.

30. Capacity of this tank is 13,500 gallons. It measures 25x16x4-1/2 feet deep. See Hommon, "Treatment Plant," pp. 2589-2590.

31. This machine was manufactured by the Wallace & Tiernan Company New Jersey, serial no. 10180.

32. Hommon, "Treatment Plant....", p. 2589.

33. Due to hazards, the gas cylinders and regulators were moved into a small lean-to built onto the back of the filter room.

34. Hommon, "Treatment Plant.....", p. 2589.

35. Ibid p. 2591.

36. Ibid. p. 2597.

37. For an interesting look at the politics of early decisions about treating sewage, see Joel A. Tair & Francis C. McMichael. Decisions about Wastewater Technology. Paper presented at Annual Convention, American Society of Civil Engineers, Sept. 1976.

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The following is a physical description of the old wastewater plant based on a February 1986 site visit.

The old water reclamation plant consists of a 1200 square foot wood frame and concrete main building, 2275 square feet of concrete tanks adjacent to the main building, a 400 square foot backwash settling basin with pumphouse, and a 4500 square foot concrete water storage tank and pumphouses. The utilitarian function of the structure is reflected in the choice of building materials and overall building form and construction evolution.

Plant Components

The corrugated metal water tank used to backwash the filters is found 100 yards northwest of the main building appearing with flaking paint, but otherwise in good condition. The wastewater settling basin and frame pumphouse are about 40 feet south of the main building. The pumphouse is delapidated. The concrete basin appears as if unused in many years with vegetation growing in the basin. The concrete appears in fair condition.

The concrete presettling tank and concrete parshall flume, 75 feet north of the main building, appear in use and in good condition.

The final major component is the 300,000 gallon water storage tank with its adjoining concrete pumphouse. Both facilities appear structurally sound. Cracked windows and peeling interior paint are found at the pumphouse.

Site

The area adjacent to the main building is enclosed by a 6'0" chain link fence which adjoins the east wall of the aeration tanks proceeding north and west and returning to the east wall of the main building.

The fence is relatively new and it has standards for a three strand barbwire above, however, no barbwire is in place.

Clarifier, Aeration and Mixing Tanks

In general, the concrete tanks adjacent to, and within the building are in good condition though paint or sealant applied to interiors is flaking off. Some minor spalling is found at the southeast corner of the east aeration tank.

According to various construction drawings, the tank walls are typically 10 inches thick with heavy reinforcing; in some instances, the reinforcement is found on both faces of the walls.

Access to tanks and clarifier mechanisms is provided by a catwalk with pipe railing system installed in 1934.

MAIN BUILDING

A. Exterior

The main building is a two-story structure dating from its original 1925 construction and various additions dating 1932, 1934, 1936 and later.

It houses a laboratory, chlorinator equipment, office space, an air pump room, boiler, toilet, coal storage, and tool room.

The building itself is in surprisingly good condition, given its 60 years of age. The exterior walls are found with vertically placed corrugated metal siding. The paint here is in poor condition and has totally come off in some locations. Very little deterioration of the siding itself is evident, however, there is some which has pulled away from the framing.

Exterior doors, windows, and their frames and trim are typically in very deteriorated condition.

The roll roofing on the entire structure is deteriorated.

Roof sheathing on the upper gable roof is in good condition with the exception of approximately 20 square feet on the west side, central area which has rotted.

The lower south shed roof sheathing is about 50 percent badly deteriorated.

b. Interior

The interior finishes consist of wood plank and concrete floor, shiplap, and some concrete walls and board ceilings. Ceiling above stairwell is water damaged due to roof leak above. The existing interior finish materials themselves are typically in sound condition, however, paint is found flaking and crazing on most surfaces. The ceiling of the south shed roofed portion of the building consists of the underside of the roof sheathing.

Various floor openings are now covered with open grates and steel plates.

c. Structural

The structural wood framing and conc-ete appears sound throughout with the exception of the lower floor shed roof, again the south half of which is deteriorated.

d. Mechanical

The bathroom fixtures in the southeast lower floor are not operational. The same applies to the laboratory sink and water heater found in the southwest room of the upper floor.

The heating system consists of an operational oil fired boiler with radiators.

e. The lighting system consists of exposed incandescent bulbs served by rigid steel conduit.

Construction Chronology

The modifications which occurred to the plant are as follows:

- 1925: original construction
- 1932: boiler room addition to south end of main building
- 1934: catwalks installed over aeration and clarifier tanks; second addition to south end of main building to house tool room, wood and coal storage, and toilet.
- 1936: laboratory extended to north, clarifier and mixing tank addition
- 1938: 300,000-gallon water storage tank and pumphouse constructed 150 feet ± south of main building
- by 1951: laboratory extended to south, aeration tank added to east of existing aeration tank
- by 1975: small shed addition on east side of main building to house chlorinator equipment

Current Plans

The historic plant will be operationally abandoned and the structures stabilized in 1987-88. The 300,000-gallon water storage tank will be used in conjunction with the new water system.

Expansion of the newer sewage treatment plant in 1987 will allow it to perform the functions of the historic water reclamation plant.

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August 1986